

CHAPTER 2 | PURPOSE AND NEED: BACKGROUND

2.1
PURPOSE AND NEED
FOR RESTORATION

Mining and mining-related activities contributed to cadmium (Cd), lead (Pb), and zinc (Zn) contamination at a variety of locations within Cherokee County. Cadmium, lead, and zinc are hazardous substances, and there is little doubt that many natural resources within the County—such as rivers, soils, plants, and animals—are, and/or have been injured by exposure to these metals (State of Kansas and DOI 2003). Although the full extent of these injuries has not yet been evaluated, there is a clear need to restore, rehabilitate, replace, and/or acquire the equivalent of the injured natural resources and the services they provide. Chapter 4 describes in more detail available information about the nature and extent of metals-related injuries to Cherokee County’s natural resources.

The purpose of this RP/EA is to determine the best way(s) to use the funds available from the Eagle-Picher and LTV bankruptcy proceedings, and any other funds that may be similarly acquired in the future, to compensate the public for past and ongoing mining-related injuries to Cherokee County natural resources. The RP/EA considers a number of restoration alternatives and evaluates them according to a number of factors such as technical feasibility, cost effectiveness, and other considerations, and serves as a plan for implementing the selected alternative as required under the Department of Interior’s Natural Resource Damage Assessment regulations as set forth at 43 CFR Part 11.

2.2
AUTHORITIES AND
LEGAL
REQUIREMENT

This section briefly reviews a number of laws, executive orders, and DOI policies that provide the legal framework for this RP/EA. The discussion begins with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) because it is the authorizing legislation behind the mining-related remedial actions that have taken place to date within Cherokee County. CERCLA is discussed both as the authorizing legislation for the Superfund program and for ongoing natural resource damage assessment activities in the area. The National Environmental Policy Act of 1969 (NEPA) is then discussed, followed by a number of additional relevant authorities.

CERCLA AND SUPERFUND: CHEROKEE COUNTY SITE HISTORY

CERCLA is the authorizing legislation for the U.S. Environmental Protection Agency’s (EPA) Superfund program. Under this authorization, and beginning over two decades ago, EPA started its evaluation of the Tri-State Mining District. EPA’s evaluation focused on threats posed to human health and the environment by mining-related releases of hazardous substances, particularly metals. Based on the results of its evaluation, EPA placed each state’s portion of the Tri-State Mining District on its National Priorities List (NPL), and each state’s portion of the district became one or more distinct Superfund

sites.⁵ The resulting Superfund sites are: the Oronogo-Duenweg Mining Belt Superfund Site (Jasper County, MO), the Newton County Superfund Site (Newton County, MO), the Cherokee County Superfund Site (referred to hereafter as the Cherokee County Site), and the Tar Creek Superfund Site (Ottawa County, OK). The Cherokee County Site was added to the NPL in 1983.

EPA has divided the Cherokee County Site into a number of subsites, and into different operable units (OUs).⁶ These divisions facilitate the identification, selection, and implementation of remedial activities at the sites. Exhibit 3 shows the seven subsites within the Cherokee County Site. EPA has conducted cleanups at some of the identified OUs, while cleanup actions for others are planned or are otherwise in progress. Exhibit 2 shows which OUs are associated with which subsites.

EXHIBIT 2 CHEROKEE COUNTY OPERABLE UNIT - SUBSITE ASSOCIATIONS

OPERABLE UNIT	SUBSITE
1 - Alternate water supply	Galena
2 - Spring River	N/A
3 - Mining and milling wastes	Baxter Springs
4 - Mining and milling wastes	Treece
5 - Ground water and surface water	Galena
6 - Mining and milling wastes	Badger, Lawton, Waco, Crestline
7 - Residential soils	Galena

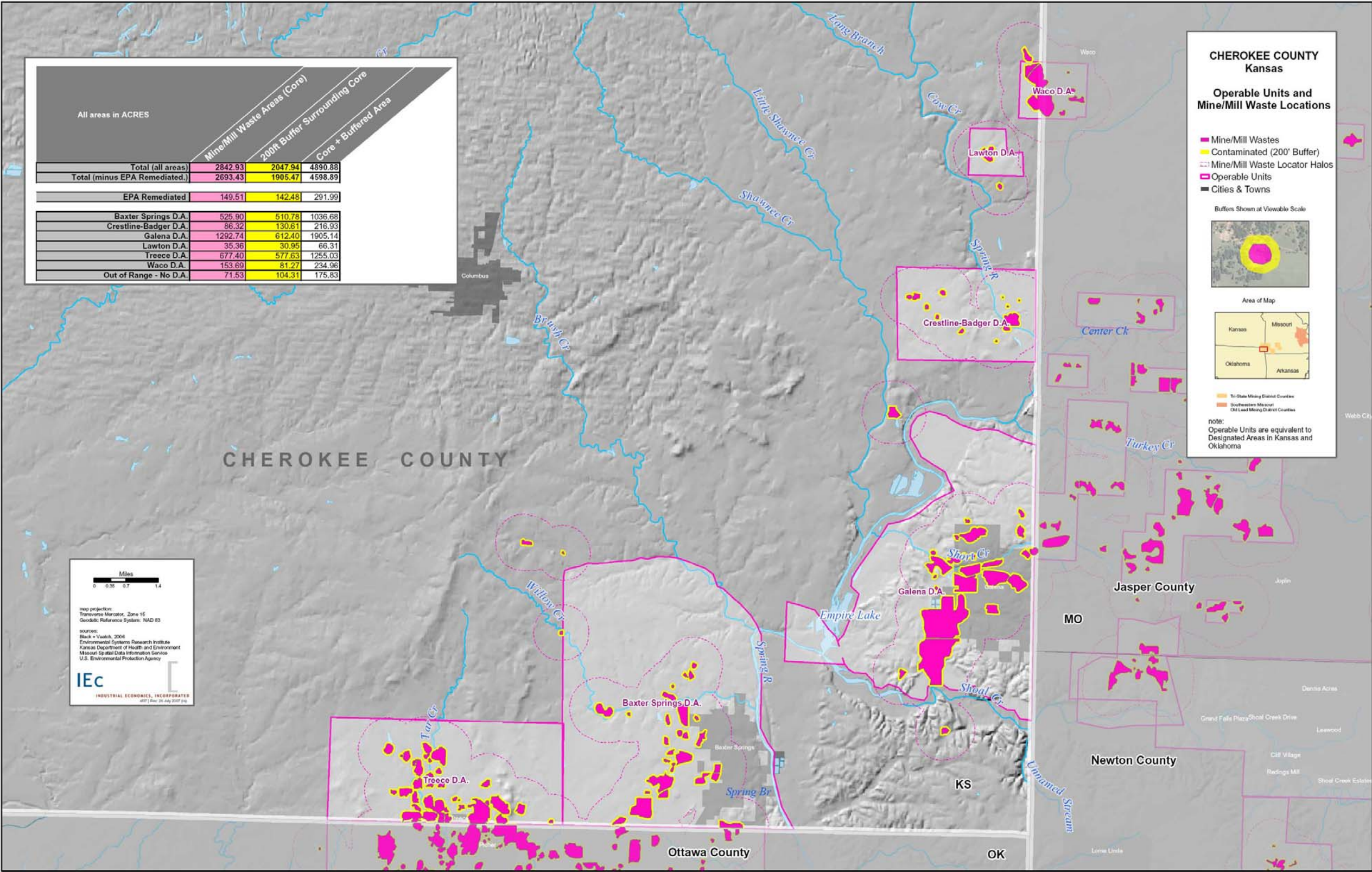
Restoration alternatives discussed in this RP/EA are not intended to replace or duplicate efforts undertaken by EPA or other organizations. They are intended to address areas of contamination for which no current EPA or other remediation plans exist, or residual resource injuries in areas where remedial actions have occurred or will occur. The restoration alternatives described here may also address interim losses⁷ to natural resources.

⁵ The NPL is a list of the worst hazardous waste sites that have been identified by EPA. The list is primarily an information resource that identifies sites that may warrant cleanup. The NPL is operated under the auspices of EPA's Superfund Program, the Federal government's CERCLA-authorized program to clean up the nation's uncontrolled hazardous waste sites.

⁶ A subsite is a geographically distinct portion of a Superfund site. An operable unit is a term for each of a number of separate activities undertaken as part of a Superfund site cleanup. For example, the Galena subsite in Cherokee County has several operable units, including residential soils, ground water/surface water, and alternate water supply.

⁷ Interim losses are measurable, adverse reductions in the quality or viability of a natural resource. Interim losses are those losses occur between the time of initial injury and the time at which the resource's condition is restored to baseline (*i.e.*, to the condition it would have had in the absence of the contaminant release). Within certain legal limits, Trustees are allowed to pursue compensation for interim losses to natural resources, even if the resources have fully recovered.

EXHIBIT 3 CHEROKEE COUNTY SUPERFUND SITE: DESIGNATED AREAS AND MINE/MILL WASTES



CERCLA AND NATURAL RESOURCE DAMAGE ASSESSMENT (NRDA)

In addition to providing the legal framework for EPA's Superfund program, CERCLA (43 CFR Part II) authorizes designated Trustees of natural resources the authority to act on behalf of the public to recover damages for injuries to natural resources and to restore, rehabilitate, replace, or acquire the equivalent of the injured natural resources and their associated services. Under Section 107(F) of CERCLA and Section 311 of the Federal Water Pollution Control Act 33 USC §1251 *et seq.* (more commonly known as the Clean Water Act, CWA), and other applicable Federal and State laws, including subpart G of the National Contingency Plan (NCP) 40 CFR §§ 300.606-300.615, the State of Kansas and the U.S. Department of the Interior (DOI) are the Trustees for the natural resources in Cherokee County (State of Kansas and DOI 2003). Natural resources include surface waters (rivers, lakes, streams, *etc.*), ground water, soils, air, plants, and wildlife. As Trustees, the State of Kansas and DOI serve as stewards for these resources within Cherokee County and have the authority to assess potential contaminant-related injuries to them.

The process through which the Trustees evaluate injuries associated with the release of hazardous substances and determine appropriate compensation for those injuries is called natural resource damage assessment (NRDA). NRDA complements EPA Superfund actions by providing a means to restore injured natural resources to the condition they would have been in but for unpermitted contaminant releases, and to compensate the public for interim lost services provided by those resources.

The Trustees are partway through the NRDA process. A damage assessment plan has been produced,⁸ which describes the currently-planned activities for investigating and quantifying potential mining-related injuries to Cherokee County's natural resources. The investigation and quantification of these injuries is not complete, however, and no other plans or approaches for restoring, replacing, or acquiring the equivalent of the injured natural resources and their services, have yet been developed as part of the NRDA process.

NATIONAL ENVIRONMENTAL PROTECTION ACT (NEPA) OF 1969

As noted previously, this restoration plan also serves as an environmental assessment under NEPA and as such has been prepared in accordance with NEPA (42 U.S.C. §§4371 *et seq.*) as amended, its implementing regulations (40 CFR §§1500 *et seq.*), and the Department of the Interior's Department Manual, Part 516.

OTHER AUTHORITIES

As described below, FWS has taken (or will take) specific steps to comply with applicable laws, Executive Orders, and departmental policies.

⁸ The assessment plan can be viewed at <http://mountain-prairie.fws.gov/nrda/CherokeeCounty.htm>.

Clean Air Act of 1970, as amended. Emissions anticipated from the implementation of any project alternative would be of short duration and designed to comply with the State of Kansas ambient air quality standards.

Clean Water Act of 1972, as amended. If one or more of the dredging alternatives⁹ were to be pursued, it would be necessary to obtain a permit from the U.S. Army Corps of Engineers, which administers the permit program authorized under Section 401 of the Clean Water Act. However, currently available funding is insufficient for implementation of these alternatives. FWS therefore does not anticipate the need for a CWA permit at this time

Endangered Species Act of 1973, as amended. This act requires Federal agencies to determine whether their actions may adversely affect any federally listed or proposed threatened or endangered species. If so, formal consultation pursuant to Section 7 of the Endangered Species Act (ESA) must be initiated with the U.S. Fish and Wildlife Service. No irreversible or irretrievable commitment of resources may be made by the Federal agency prior to completion of formal consultation. As part of the public review and comment process, a copy of this draft RP/EA will be provided to the U.S. Fish and Wildlife Service's Ecological Services Field Office to begin the consultation process pursuant to Section 7 of the ESA. In addition, the Trustees will consult on a project specific basis.

Farmland Protection and Policy Act of 1981. This act aims to protect farmland and reduce urban sprawl. No activities proposed under this RP/EA increase urban sprawl. Although some activities proposed in this document may remove lands from agricultural use, these areas will be preserved and/or returned to a more native-like, natural state. Furthermore, no active restoration actions would occur without landowner permission.

Information Quality Act of 2001. The information presented in this RP/EA meets the requirements of the IQA, including quality, utility, objectivity, and integrity.

Migratory Bird Treaty Act of 1918, as amended. No actions proposed in this RP/EA will result in the taking of migratory bird species. Rather, proposed projects are intended to reduce the risk of injury to a variety of species, including migratory birds, and to provide improved quantity and quality of habitat.

National Historic Preservation Act of 1966, as amended. FWS will provide the State of Kansas Historic Preservation Officer with this RP/EA as part of the public review and comment process, requesting their input to ensure project compliance with Section 106 of the National Historic Preservation Act. There are no local tribes with whom to consult on the issues of threatened or sensitive tribal sites, or traditional heritage properties.

National Wildlife Refuge System Administration Act of 1966, as amended. No national wildlife refuges are present in Cherokee County. The project alternatives in this RP/EA will not have any significant adverse effects on refuges outside of the county.

⁹ The dredging alternatives, as well as all other alternatives considered, are described in Chapter 3.

Executive Order 11988, *Floodplain Management*. directs all Federal agencies to take action to avoid, to the extent possible, the long- and short-term impacts associated with the occupancy and modification of floodplains. The project alternatives in this RP/EA will not have any significant adverse effects associated with modification and occupancy of floodplains.

Executive Order 11990, *Protection of Wetlands*. Implementation of any project alternative in this RP/EA is not anticipated to have or cause any significant adverse effects on wetlands.

Executive Order 12898, *Environmental Justice*. Implementation of any project alternative in this RP/EA is not anticipated to cause disproportionate adverse human health or environmental effects to minority or low-income populations. Implementation of any restoration actions in this plan requires the participation of willing landowners.

Executive Order 12962, *Aquatic Systems and Recreational Fisheries*. Executive Order 12962 directs Federal agencies to add additional public access to fisheries nationwide by conserving, restoring, and enhancing aquatic systems. Implementation of some project alternatives in this RP/EA may cause short-term adverse effects to aquatic systems but will be designed to minimize these effects and to maximize long-term benefits to aquatic systems.

Executive Order 13007, *American Indian Sacred Sites*. Executive Order 13007 directs Federal agencies to accommodate access to and ceremonial use of American Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites. Implementation of any project alternative in this RP/EA will not affect access or ceremonial use of American Indian sacred sites.

Executive Order 13045, *Protection of Children*. Implementation of any project alternative in this RP/EA is not anticipated to cause disproportionate environmental health or safety effects to children.

Executive Order 13112, *Invasive Species*. Implementation of any alternative in this RP/EA will use existing integrated pest management strategies to prevent the introduction of invasive species, such as noxious weeds, and will not authorize or carry out actions that are likely to cause the introduction or spread of invasive species.

Executive Order 13186, *Protection of Migratory Birds*. Implementation of any alternative in this RP/EA is not anticipated to cause measurable negative effects on migratory bird populations.

DOI Departmental Manual, Parts 517 and 609, *Pesticides and Weed Control*. Consistent with DOI policy, implementation of any alternative in this RP/EA will use integrated pest management strategies. Pesticides will be used only after a full consideration of alternatives, and if used, the least hazardous material that will meet restoration objectives will be chosen.

DOI Departmental Manual, Part 518, *Waste Management*. Consistent with DOI policy, any alternative selected in this RP/EA will seek to prevent the generation and

acquisition of hazardous wastes, but when waste generation or acquisition is unavoidable, sound waste management practices will be used. Wastes will be managed responsibly to protect resources and people who come in contact with the affected areas. Also consistent with DOI policy, aggressive measures will be used to clean up and restore these areas. Any restoration alternatives undertaken will comply with Federal, State, interstate and local waste management requirements, including payment of fees required for registrations and permits. Any required assessments, monitoring, pollution prevention, recordkeeping, reporting, response actions and training will take place on a timely basis.

DOI Departmental Manual Part 602: Land Acquisition, Exchange and Disposal.

Consistent with DOI policy, any selected alternative that involves land acquisition will comply with appropriate pre-acquisition standards, particularly ASTM Standards on Environmental Site Assessments for Commercial Real Estate effect at the time. Pre-acquisition assessments will be done by qualified individual(s) and will be done within 12 months of the date of acquisition. Any required approvals will be obtained, and acquisition conditions set out in Part 602 will be met.

341 FW 3. Pre-Acquisition Environmental Site Assessments. All conditions set forth in FW3, including environmental site assessment requirements, including pre- and post-acquisition requirements, Level I, II, or III assessment, assessment standards and conditions, retention of records, and time limits will be met.

2.3 PUBLIC PARTICIPATION Public participation is required by NEPA (40 CFR §1506.6) and is a very important part of restoration plan development. Part 516 of DOI's Department Manual addresses NEPA compliance and specifies that DOI's policy is, "[t]o the fullest practicable extent, to encourage public involvement in the development of Departmental plans and programs through State, local, and tribal partnerships and cooperative agreements at the beginning of the NEPA process, and to provide timely information to the public to better assist in understanding such plans and programs affecting environmental quality" (DOI 2004). Procedures for public involvement, wherever appropriate, will include "provision for public meetings in order to obtain the views of interested parties, newsletters, and status reports of NEPA compliance activities" (DOI 2004).

FWS notes that the State of Kansas is reviewing this plan and is providing input. Additional comments and input on this RP/EA from the public are encouraged and will be accepted during a period of 30 days after the release of this draft RP/EA. Members of the public may e-mail comments to CherokeeCountyRestoration@fws.gov.

Alternately, the public may send comments to:

Cherokee County Restoration
U.S. Fish and Wildlife Service
Kansas Field Office
2609 Anderson Ave.
Manhattan, KS 66502

In addition, FWS intends to set up a series of public meetings during which members of the public may express their views and ask questions about this RP/EA. These meetings have not yet been scheduled, nor have their locations been selected. When this information is available, it will be posted to the following website:

<http://mountain-prairie.fws.gov/nrda/CherokeeCounty.htm>.

When a final RP/EA is available, it will be posted on the above website. Draft and final copies also will be provided to the Columbus, Baxter Springs, and Galena Public Libraries.

2.4 MINING IN CHEROKEE COUNTY AND THE TRI-STATE MINING DISTRICT

The Tri-State Mining District is approximately 2,500-square miles in area and includes Cherokee County, which is located in the southeastern corner of Kansas (Exhibit 3). For over a century, portions of this county and neighboring counties in Missouri and Oklahoma were extensively mined for lead and zinc. Indeed, for the period 1850-1950, the district produced 50 percent of the zinc and 10 percent of the lead in the United States. Altogether, the mines in the area produced 23 million tons of zinc concentrates and four million tons of lead concentrates (Brosius and Sawin 2001). The Tri-State Mining District ranks first in terms of past zinc production in the United States, and fourth in terms of past lead production (Long *et al.* 1998). Production in Cherokee County peaked in the 1920s and 1930s, then diminished until it ceased in the 1970s (Dames & Moore 1995; State of Kansas and DOI 2003).

HISTORY OF MINING IN CHEROKEE COUNTY: OVERVIEW

Although shallow mining was used in some areas such as Galena (Brosius and Sawin 2001), most mining operations in the district used underground techniques (Dames & Moore 1993a). Room-and-pillar methods, in which rooms were mined for their ore while leaving pillars to support the roof, were common (Brosius and Sawin 2001). Some of the mined rock layers were aquifers—that is, they were saturated with ground water—such that constant pumping was required to keep the mines dry as mining operations continued (Dames & Moore 1993a).

Dames & Moore (1993a) indicates that "[e]arly mining was characterized by a multitude of small operators on 40-acre tracts with each operator conducting mining, drilling, and milling operations. This resulted in numerous shafts, waste piles, and mine structures." When higher grade ore deposits were depleted in the 1930s, larger companies could still profitably operate in the area due to central milling practices and improved technologies (Dames & Moore 1993a).

Once removed from the mines, ore was processed, and this processing produced a variety of wastes, including waste rock, chat, and tailings:

- Waste rock, known as bullrock (Exhibit 4), consists of cobble to boulder-sized rocks that were excavated but not milled. Bullrock includes rock that overlay an ore body, rock removed in the creation of air shafts, and mined rock containing little usable ore (Dames & Moore 1993a).

- Chat (Exhibits 5 and 6) consists of a mixture of gravel- to fine-sized mill waste, often mixed with sand-sized particles. Chat was produced as part of the initial milling of the mined rock. Chat piles are a dominant geographic feature in the Tri-State Mining District, although much of the gravel-sized chat in Cherokee County has been removed and sold as fill for roadbeds or for other uses (Dames & Moore 1993a).
- Tailings (Exhibit 7) are sand and silt-sized mine wastes, left over after the final milling of the ore and the flotation of metals from crushed rock, or created as a by-product of washing chat. Tailings were usually sluiced into a dammed pond in a water slurry. Therefore, most tailings are located where the old ponds were located and some continue to contain ponded water (Dames & Moore 1993a).

EXHIBIT 4 BULLROCK PILE IN LAWTON



Photo courtesy of John Miesner, U.S. Fish and Wildlife Service.

EXHIBIT 5 CHAT IN CRESTLINE



Photo courtesy of John Miesner, U.S. Fish and Wildlife Service

EXHIBIT 6 CHAT PILE IN TREECE



Photo courtesy of John Miesner, U.S. Fish and Wildlife Service

EXHIBIT 7 TAILINGS IN CRESTLINE



Photo courtesy of John Miesner, U.S. Fish and Wildlife Service

Mining wastes once covered 4,000 acres in southeastern Cherokee County (Brosius and Sawin 2001). Although much of the Kansas wastes have been removed, a considerable quantity still remains. As of 1993, the Treece and Baxter Springs subsites alone contained 3.2 million cubic yards of chat and 4.2 million cubic yards of other wastes such as tailings and bullrock, both of which covered about 1,250 acres (Dames & Moore 1993a). Wastes, including piles subject to remedial action by the U.S. Environmental Protection Agency, are still present on almost 3,000 acres.

Smelting, the process of melting or fusing ore for the purpose of separating and refining the metal, also contributed to heavy metal contamination in Cherokee County. Initially, there may have been crude log smelters associated with each mine (Dames & Moore 1995). In addition, an Eagle-Picher smelter operated at Galena from about 1920 to 1970 (USACE 1995).

HISTORY AND LOCATION OF EAGLE-PICHER MINING ACTIVITIES

Eagle-Picher Industries, Inc. has over 150 years of manufacturing experience with a current focus of supplying industry with machinery and parts (Pederson 1999). Established in 1842, the company was incorporated in 1867 as Eagle White Lead Company in Cincinnati, Ohio. Eagle White Lead Company consolidated with Picher Lead Company, a Missouri corporation, to form the Eagle-Picher Lead Company (EPLC) in 1916 (Pederson 1999, Knerr 1992). In 1930, EPLC formed a new mining subsidiary,

incorporated in Delaware, Eagle Picher Mining & Smelting (EPM&S).¹⁰ Due to a number of other corporate changes throughout the years, Eagle-Picher is a corporate successor to EPLC and EPM&S. Eagle-Picher filed a petition under Chapter 11 of the Bankruptcy Code on January 7, 1991.¹¹ A settlement agreement between Eagle-Picher and its creditors was entered into on March 27, 1995 and upheld on June 6, 1996.¹²

Eagle-Picher and its subsidiaries and predecessors owned and operated property in the Tri-State mining district, conducting mining operations in the Tri-State area from the 1840s to the 1950s.¹³ In the early 20th century, Eagle-Picher was the leading zinc producer in the country and was also one of the largest lead producers (Pederson 1999). Among its operations were a lead smelter at Galena, Kansas, a zinc smelter in Henryetta, Oklahoma and a "central mill" at Picher, Oklahoma.¹⁴ A number of sites were affected by Eagle-Picher's activities, including the Baxter Springs and Treece subsites in Cherokee County, Kansas and the Oronogo-Duenweg Superfund Site in Missouri, among others.¹⁵ The company operated smelting operations in the Joplin area (Pederson 1999), and Eagle-Picher mined the Picher field along the Oklahoma-Kansas border for lead and zinc ores between 1904 and 1970¹⁶; this area was listed on the National Priorities list due to contamination of surface water at Tar Creek and area ground water.¹⁷ Eagle-Picher facilities also contributed to contamination at Galena, Spring River, and Empire Lake, and may have also contributed to contamination at the OU6 site.

HISTORY AND LOCATION OF LTV MINING ACTIVITIES

The LTV Corporation was a conglomerate whose business was concentrated in the steel, aerospace, and energy production industries. The company was first incorporated in 1956 as Ling Electronics, Inc. and in the late 1950s and early 1960s went through several mergers to become Ling-Temco-Vought (Pederson 1999). In 1971, after a series of acquisitions and divestments, this conglomerate became The LTV Corporation (Pederson 1999). At one point in time, LTV was the third largest steel producer in the United States (Pederson 1999).

The LTV Corporation and sixty-six of its affiliates filed for Chapter 11 bankruptcy protection on July 17, 1986.¹⁸ This bankruptcy protection lasted for almost seven years, during which the company overhauled its steel operations, closing or selling many plants

¹⁰ Eagle-Picher Mining & Smelting Co. v. NLRB, 119 F.2d 903, 907 (8th Cir. 1941).

¹¹ In Re Eagle Picher Industries, Inc., 164 B.R. 265, 267 (S.D. Ohio, 1994).

¹² In Re Eagle Picher Industries, Inc., 197 B.R. 260, 262-271 (S.D. Ohio, 1996).

¹³ In Re Eagle Picher Industries, Inc., 197 B.R. 260, 267 (S.D. Ohio, 1996).

¹⁴ Eagle-Picher Mining & Smelting Co. v. NLRB, 119 F.2d 903, 907 (8th Cir. 1941).

¹⁵ In Re Eagle Picher Industries, Inc., 197 B.R. 260, 263 (S.D. Ohio, 1996).

¹⁶ The Oklahoma portion of this field was mined through 1958; the Swalley Mine at Baxter Springs in Kansas operated until 1970 (McCauley *et al.* 1983, Brady 2000).

¹⁷ Eagle-Picher Industries, Inc. vs. United States EPA, 822 F.2d 132, 137 (D.C. Cir. 1987).

¹⁸ In re Chateaugay Corporation, et al., 115 B.R. 760, 762 (S.D.N.Y. 1990).

and changing its focus, although it remained primarily a steel producer (Pederson 1999). On December 29, 2000, LTV, its parent company, and other related companies filed a voluntary petition for reorganization under Chapter 11 of the Bankruptcy Code in the Northern District of Ohio, Eastern Division.¹⁹ As a corporate successor of the Vinegar Hill Zinc Company, LTV contributed to contamination at the Baxter Springs and Treece subsites in Cherokee County. LTV also contributed to contamination in Spring River, Willow Creek, and Tar Creek.

MINING ACTIVITIES OF OTHER PARTIES

In addition to Eagle-Picher and LTV, other mining and mining-related companies have contributed to contamination in and injuries to Cherokee County's natural resources. In the future, FWS may recover damages associated with these injuries. FWS intends to use this restoration plan not only for damages it has received from Eagle-Picher and LTV but also to focus possible restoration actions associated with potential future recoveries from other potentially responsible parties.

MINING AND METALS CONTAMINATION

Mining activities release metals into the environment through a variety of pathways. During periods of active mining, sources of metal contamination include dewatering operations and releases from the vast piles of mine wastes (bullrock, chat, and tailings) generated by mining activities. Mine wastes frequently contain elevated levels of metals, contaminating soils in and around the piles. This contamination can persist, not only for the period of active mining and not only in the mine wastes, but also in adjacent areas and for many years afterwards. In the Baxter Springs and Treece subsites, for example, researchers found that "average concentration of Cd, Fe [iron], Pb, Mn [manganese], and Zn are above baseline levels for non-agricultural soils in the immediate vicinity of surficial waste piles" (Dames & Moore 1993a).

In addition to contaminating adjacent soils, chat piles collect water, resulting in "perched water" within the piles (Dames & Moore 1993a). The porous, granular mill waste accumulations act as precipitation storage sites, slowly releasing contaminated water after a recharge event (Dames & Moore 1993a). Streams and ponds that receive drainage from perched water or water that filters through mine and mill waste deposits have elevated metals concentrations relative to upstream areas (Dames & Moore 1993a).

Waste piles on the surface also increase ground water recharge by impeding runoff, as water is both retained in pore spaces in the piles and physically impeded from becoming runoff (CH2M 1987). This puts highly oxygenated rain water into contact "with a much larger quantity (surface area) of metal-rich sulfide minerals than originally present in the premining condition," and may increase contaminant levels in ground water.

Contaminated ground water in turn can contribute to metals loading in some streams. For instance, the Boone aquifer discharges to the streambeds of Spring River tributaries (Dames & Moore 1993a).

¹⁹ In re LTV Steel Co., Inc., 264 B.R. 455 (Bankr. N.D. Ohio, 2001).

When active mining ceased, pumping of the excavated areas stopped, and the remaining rooms and tunnels filled with water. This water became contaminated by contact with the ore remaining in the mine walls or left behind by the miners (Brosius and Sawin 2001), and some leached into surrounding areas of ground water and/or discharged to surface waters. These discharges can continue for long periods of time. For example, the Bruger shaft still discharges into Willow Creek, decades after cessation of mining operations.

Sometimes pillar-robbing occurred during the last stages of mining. In this practice, pillars that had previously been left intact to hold up the cavern's roof were removed. As a result, the roofs of underground workings collapse, resulting in the formation of subsidences, which may fill with water and become subsidence ponds (Brosius and Sawin 2001) (Exhibit 8). Subsidence ponds and remaining chat/tailings ponds can release wastes into surface waters and/or ground water for many years. For instance, the Spring Branch, an ephemeral creek that runs through the Baxter Springs subsite, is "entirely contained within an area impacted by mining and streamflow [was] supported, at least over the short term, by seepage from a large chat-wash pond (Ballard Pond)" such that it was believed that much of the dissolved cadmium present within the stream originate[ed] from this industrial pond"²⁰ (Dames & Moore 1993b).

The result of all these activities is past and ongoing exposure of natural resources - land, water, and biota - to harmful substances, likely causing injuries to the natural resources and losses of associated services.

EXHIBIT 8 SUBSIDENCE POND AT SUNFLOWER MINE IN BAXTER SPRINGS



Photo courtesy of John Miesner, U.S. Fish and Wildlife Service

²⁰ This area was addressed in the EPA's 1997 ROD for the Baxter Springs/Treece subsite: "[t]ailing impoundments...in the Spring Branch Drainage and...in the Willow Creek drainage will be drained, filled, regraded, recontoured, capped with

2.5 CONTAMINANTS OF CONCERN

Although mining and related activities can cause the release of a number of different potentially hazardous metals to the environment, most studies have focused on cadmium (Cd), lead (Pb), and zinc (Zn), contaminants that have significant potential for toxicity to many plants and animals. These metals are commonly found at elevated levels in soils, sediments, and surface waters throughout Cherokee County, and although NRDA activities are ongoing, substantial relevant data suggests that these metals may be adversely affecting Cherokee County natural resources. The following paragraphs provide some general information about the potential adverse effects of these metals on organisms.

CADMIUM

Cadmium (Cd) is a soft metal that is found naturally in conjunction with zinc. Cadmium is used in electroplating, solder, nickel-cadmium batteries, and in rods to control atomic fission. Cadmium is not biologically essential or beneficial to any known living organism and is toxic to all known forms of life (Eisler 2000). Freshwater²¹ animals tend to be most heavily impacted by cadmium contamination (WHO 1992). Impacts to freshwater animals include death, reduced growth, and inhibited reproduction (Eisler 2000). In freshwater systems, the lethal effects of cadmium can be reduced by limiting exposure time and increasing water hardness²² (Eisler 2000). Sublethal effects of cadmium in freshwater organisms include decreases in plant standing crop, decreases in growth, inhibition of reproduction, immobilization, and population alterations (Eisler 2000). Mammals and birds are comparatively resistant to the toxic²³ effects of cadmium, though exposure to high levels can be fatal (Eisler 2000).

Animals can be exposed to environmental cadmium through inhalation or ingestion. Cadmium is a known carcinogen, a known teratogen, and a probable mutagen (Eisler 2000; ATSDR 1999a). Studies investigating carcinogenicity have focused on mammals. Cadmium has been shown to cause tumors in the prostate, testes, and hematopoietic (blood-related) systems in rats (ATSDR 1999b). Based on studies in mice and bacteria, cadmium may be mutagenic (Ferm and Layton 1981 as cited in Eisler 2000). When present, cadmium is detected in particularly high concentrations in the leaves of plants and the livers and kidneys of vertebrates (ATSDR 1999b; Scheuhammer 1987 as cited in Eisler 2000).

soil/clay cover systems, and revegetated to prevent deposition of tailings in Spring Branch and Willow Creek during storm events. Approximately 28 acres of tailings, which are surface water loading sources, will be remediated under this action."

²¹ Freshwater refers to waters that are not saline (salty).

²² Water hardness is a measure of the content of certain naturally-occurring elements in water, especially calcium and magnesium.

²³ Toxins cause direct injury to an organism as a result of physiochemical interaction. Carcinogens cause cancer (for example, tumors, sarcomas, leukemias). Mutagens cause permanent genetic change. Teratogens cause abnormalities during embryonic growth and development.

LEAD

Lead (Pb) is a soft metal whose past and/or current uses include the manufacture of batteries, ammunition, plumbing fixtures, paint, and as an additive for gasoline. Lead is not biologically essential or beneficial to any known living organism (Eisler 2000). It can be incorporated into the bodies of individual organisms by inhalation, ingestion, absorption through the skin, and (in mammals), placental transfer from the mother to the fetus (Eisler 2000). Toxic in most chemical forms, lead negatively affects survival, growth, reproduction, development, and metabolism of most animals under controlled conditions, but its effects are substantially modified by numerous physical, chemical, and biological variables. Younger, immature organisms tend to be more susceptible to lead toxicity (Eisler 2000). When absorbed in excessive amounts, lead has carcinogenic or co-carcinogenic properties (Eisler 2000). In large amounts, it is also a mutagen and a teratogen (Eisler 2000).

Aquatic animals have been demonstrated to experience adverse effects such as reduced survival, impaired reproduction, and reduced growth (Eisler 2000). As with cadmium, increased water hardness decreases lead bioavailability to aquatic animals (Wong *et al.* 1978 and NRCC 1973, both as cited in Eisler 2000). Early research suggested that birds are unlikely to show adverse effects from environmental lead (except when lead objects such as shot are directly ingested); however, there is now a growing body of evidence linking waterfowl poisoning with ingestion of lead-contaminated sediments, especially in the Coeur d'Alene area of Idaho (Chupp and Dalke 1964, Blus *et al.* 1991, Beyer *et al.* 1998, Heinz *et al.* 1999, all as cited in Eisler 2000). There are few data regarding the effect of environmental lead on mammalian wildlife (Eisler 2000).

Lead also can harm plants. Generally, large amounts must be present in soils before terrestrial plants are affected, although sensitivity varies widely between species (Demayo *et al.* 1982). Effects of lead toxicity in plants include reduced plant growth, photosynthesis, mitosis, and water absorption (Demayo *et al.* 1982).

ZINC

Zinc (Zn) is used in a wide variety of products. In alloy form, it is used to make brass, nickel silver, and aluminum solder; it also is used to galvanize other metals and prevent them from rusting. Zinc is used in coins; it is also used to manufacture rubber, cosmetics, plastics, medicines, and many other items.

An essential trace element for all living organisms, zinc deficiency in animals can cause a variety of adverse effects (Eisler 2000; ATSDR 2005). Zinc is also toxic at high concentrations, although its toxicity depends on its chemical form and other environmental parameters (Eisler 2000). Zinc is not carcinogenic, although in certain chemical forms, zinc can be mutagenic (Thompson *et al.* 1989, as cited in Eisler 2000). Zinc is teratogenic to frog and fish embryos, but there is no conclusive evidence of teratogenicity in mammals (Dawson *et al.* 1988 and Fort *et al.* 1989, both as cited in Eisler 2000).

Environmental effects of zinc can occur at relatively low concentrations (Eisler 2000). Terrestrial plants can die from excess zinc in the soil (Eisler 2000). Freshwater animals can also experience adverse effects, including reduced growth, reproduction, and survival (Eisler 2000). Ducks experience pancreatic degeneration and death when fed diets containing high concentrations of zinc (Eisler 2000).

Recent studies have found evidence of zinc poisoning in birds collected from the Tri-State Mining District (Beyer *et al.* 2004, Carpenter *et al.* 2004, Sileo *et al.* 2003). Geese had zinc concentrations in their livers that the authors state are “comparable with those in waterfowl killed by Zn in laboratory studies or accidentally killed by ingesting zinc pennies in zoos” (Sileo *et al.* 2003). Liver and pancreas zinc levels in a Picher, Oklahoma trumpeter swan diagnosed with zinc poisoning were also elevated (Carpenter *et al.* 2004). Beyer *et al.* (2004) found significantly higher zinc levels in American robins (*Turdus migratorius*), northern cardinals (*Cardinalis cardinalis*), and waterfowl in the Cherokee County area, relative to reference site birds. Beyer *et al.* (2004) note that the increased environmental concentrations of zinc associated with mining in the area accounted for the pancreatitis previously observed in five waterfowl from the District, and that this is the first instance of free-flying birds found to be suffering severe effects of zinc poisoning.

Excess zinc can also adversely affect mammals. Mammals can generally tolerate greater than 100 times their minimum daily zinc requirement (NAS 1979, Wentink *et al.* 1985, Goyer 1986, Leonard and Gerber 1989, all as cited in Eisler 2000), but levels that are too high affect their survival, metabolism, and well-being (Eisler 2000).